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Specifications

1. Title of the Invention

A Data Output Apparatus

2. Claims

(1) A data output apparatus characterized in that, in a liquid crystal cell wherein a first substrate having a light transmission electrode and a lead and a second substrate having plural light transmission electrodes and a lead which are arranged so as to face each other, liquid crystal compositions including a liquid crystal showing ferroelectricity and a liquid crystal driver IC being mounted with one of the above facing substrates to give an electric field signal on liquid crystal components are packaged on a liquid crystal electro-optical apparatus being arranged between a photosensitive drum and a light source.

(2) A data output apparatus set forth in claim 1 wherein the above liquid crystal components have liquid crystal components including an ester combination in its main bone.

3. Detailed Description of the Invention

[Field of the Invention]

The present invention is to suggest a method to improve an apparatus to be used in output portion of a printer, facsimile to output data from a computer, word processor, and so forth, and printing portion of a copier.

[Prior Art]

In conventional data output apparatuses, put in practice are a thermal head type wherein a printing head where a resister heating portion is arranged in line shape or matrix shape is contacted a thermal paper sheet to cause thermal quality change and thereby dot transfer is conducted, and characters and figures are output, a type wherein a thermal source is contacted part of a container containing ink, and part of ink is instantaneously boiled, and is jetted from a nozzle arranged on the container onto a paper sheet, and so forth.

And as a method using a photosensitive drum, put in practice is a method wherein an output light of a semiconductor laser is radiated onto a drum by turning a Coriolis mirror, and by its repeated actions, characters and figures are output.

While, also put in practice is a method wherein a liquid crystal cell of line shape of guest host type is employed, and a light of rear illumination of a fluorescent lamp is radiated in line onto a photosensitive drum as line dot data, and by its repeated actions, characters and figures are output.

And in recent years, suggested has been a method wherein a ferroelectric liquid crystal cell is employed in the place of the guest host type liquid crystal cell.

[Problems to be Solved by the Invention]

The thermal head method and the ink jet method described in the above Prior Art column have had a problem that the limit of their response speed prevents the printing speed from going over around 60 characters in a second. While, in a data output apparatus using a semiconductor laser, a spot light source is radiated in spot onto a photosensitive drum

with length 400 mm by use of a Coriolis mirror, it is necessary to make the size of a whole apparatus large in order to secure its light path length, as a result, it is difficult to make a small size of apparatus.

A data output apparatus using a guest host liquid crystal cell is compact in size, but its liquid crystal response speed is as slow as several ten msec, therefore, a method to use a ferroelectric liquid crystal cell is newly suggested.

However, in a liquid crystal apparatus using such a ferroelectric liquid crystal, naturally required is uniform driving characteristic in a whole apparatus. For this reason, technologies have been developed so as to form a defect-free uniform liquid crystal layer, i.e., a mono domain, all over a whole liquid crystal apparatus.

However, in a liquid crystal material, especially in a ferroelectric liquid crystal having a smectic layer structure, defects are apt to occur on a layer structure owing to micro scratches on an orientational film, convex and concave of electrode for driving liquid crystal, a spacer for holding substrate clearance in a liquid crystal apparatus, and other various factors, and it is impossible to obtain a uniform mono domain, accordingly, in the prior art, efforts have been made to make a mono domain grow all over a cell by a method wherein liquid crystal is one dimensionally grown from the end portion of a liquid crystal apparatus (temperature inclination).

However, this method could not be applied when the length of a liquid crystal apparatus became long. Namely, the size of a mono domain attained by this method was about several ten millimeters square at best, so it was impossible to put the method in practical industry.

And even if a mono domain with an available size could be realized, from the characteristics of a ferroelectric liquid crystal material, a liquid crystal material and a substrate are not arranged in parallel, but are arranged with a certain inclination, as a consequence, the layer structure of ferroelectric liquid crystal may be bent or curved. When there are many bent or curved layer structures, peaks or bottoms in such a curve cause zigzag defects, which has been a problem in the prior art.

And when a liquid crystal material changes its conditions, its reverted process becomes opposite at zigzag defects by electric field from the outside. As a consequence, it was impossible to obtain a uniform driving characteristic over a whole apparatus, which has been other problem in the prior art.

Further, when a liquid crystal electro-optical apparatus is used as an optical shutter in a data output apparatus, an electric circuit for driving its liquid crystal is always required, and this driving circuit portion may become larger than the optical shutter portion in some cases.

Accordingly, there has been a great expectation for a compact and lightweight optical shutter including this driving circuit.

[Means to Solve the Problems]

Arranged between a photosensitive drum and a light source is a liquid crystal electro-optical apparatus having a means for arranging liquid crystal components in a certain direction, including liquid crystal showing ferroelectricity and liquid crystal components having an ester combination in its main bone, in a liquid crystal cell wherein a first substrate having an electrode comprising a light transmission material and a lead on a light transmission

substrate (for example, a first substrate having a SiO_2 film of thickness 1000Å on a soda lime glass of thickness 1.1mm) and a second substrate having plural light transmission electrodes and leads are arranged to face each other. At this moment, to an electric circuit portion to drive this liquid crystal, a driver IC for giving an electric field signal to liquid crystal is packaged on the second substrate configuring the above liquid crystal cell, and the output terminal of the IC and the electrode on the above substrate are electrically connected on the substrate, thereby a whole apparatus is made compact and light-weight.

And since the liquid crystal components include liquid crystal components including ester combination in main bone, it is possible to make a multi domain status, and distortion of liquid crystal orientation is alleviated by the border of the domain, there will be not significant orientation defect, and as a result, there will not be formed zigzag defects or so over a whole liquid crystal cell.

And further, this micro domain inside is in a preferable mono domain status, there will be no difference in liquid crystal display and drive in each micro domain, therefore, it is possible to realize a uniform display or driving characteristic as a whole.

In reference to the attached drawings, one preferred embodiment of the present invention is explained in details hereinafter.

[Description of Preferred Embodiment]

FIG.1 is a schematic diagram showing a cross section of a cell in a liquid crystal apparatus used in one preferred embodiment according to the present invention. And FIG.2 is a schematic diagram showing a structure of a data output apparatus. Both the figures are schematic, therefore,

dimensions are optional.

As a first substrate (1), a substrate wherein an SiO2 film of 1000Å was formed by sputtering method so as to shut off the deposition of alkali ion in a glass substrate, on a soda lime glass (of thickness 1.1mm) was used. A light transmission conductive film (2) (ITO : indium tin oxide) was formed 1100Å on the first substrate (1) by sputtering method. Thereafter, one electrode, external takeout electrode and lead were formed by photolitho method.

As the second substrate (6), in the present preferred embodiment, a substrate wherein a SiO_2 film of 1000Å was formed on a soda lime glass (of thickness 1.1mm) was used. A light transmission conductive film (5) was formed 1100Å on the second substrate. Thereafter, by use of photolitho method, 4800 pieces of printing electrodes, external takeout electrodes and leads were formed by photolitho method. The pitch of these printing electrodes was 62.5 microns.

And nickel plating of 5000Å (7) and gold plating of 500Å (8) were made on the portions of the leads and the external takeout electrodes.

A polyimide film (3) was printed onto the first substrate by offset method, and was baked by a far infrared radiation furnace at 350°C for 10 minutes to obtain an orientational film (3) of 1000Å. Thereafter, rubbing was carried out by a rubbing apparatus wherein a Chargenon (made by Asahi Kasei) was rounded around a roll, and thereby micro scratches were made in one direction on the orientational film.

A mixture wherein SiO_2 fibers of cylindrical shape having a diameter 2.2 microns were mixed by 5 weight % into one liquid type epoxy resin was printed onto the first substrate by screen method.

Thereafter, the first substrate and the second substrate were attached to each other, and then liquid crystal with ferroelectricity (SELT-500) was filled in by use of vacuum method. The filling port was sealed by an ultraviolet setting resin, and thus a liquid crystal cell was prepared.

Thereafter, a gold bump of 100 microns square and height 20 microns arranged at the output terminal of a driver IC (9) as a multiplexer to shift 8-bit data from a controller and the external takeout electrode (8) on the second substrate were electrically contacted, and the IC surface and the second substrate were connected and fixed by epoxy system resin (11), and thus a liquid crystal apparatus was prepared.

This liquid crystal apparatus was set between a light source where an LED was arranged on line and a photosensitive drum to configure a data output apparatus.

The liquid crystal cell as (22) in the present invention is arranged between an LED light source (21) and a photosensitive drum (23), and functions as a shutter to make light transmit and not transmit according to input signal, therefore, it is equipped with two sheets of deflecting plates (not illustrated herein).

In the case of the present preferred embodiment, 4800 pieces of lights a line were turned ON and OFF, and in 4800 pieces, it was possible to control turning ON and OFF the lights preferably. This is for the orientation of liquid crystal in the liquid crystal cell was in a multi domain status, and it was possible to turn ON and OFF lights uniformly in most of portions.

And all over the liquid crystal cell surface, since there were micro orientation defects, there were not large orientation defects, and there was no portion where light

turning ON and OFF appeared different from other portions.

Further, since a ferroelectric liquid crystal material was employed as a liquid crystal material, the response speed was twice to 10 times as fast as that of a conventional liquid crystal, and the output speed of an A4 size standard document appeared over twice as fast as that of a conventional apparatus.

Since an IC for driving liquid crystal was arranged on a substrate that configured a liquid crystal cell, it was possible to make the volume thereof as compact as 2/3 to 1/2 of that of a conventional product, and further it was possible to reduce the number of parts used, and as a result, the number of production processes were reduced and costs were reduced too.

[Effect of the Invention]

According to the present invention, since multi domain orientation is carried out to a liquid crystal cell in a data output apparatus, it was possible to obtain a uniform orientational status over the whole liquid crystal cell.

There were not such defects affecting upon optical characteristics as zigzag defects and so forth, and it was possible to realize uniform display characteristics and high contrast ratio.

Especially in a liquid crystal apparatus in a data output apparatus, where high contrast is required, it is possible to improve characteristics according to the present invention.

Moreover, by packaging a driver IC on the second substrate, it has been possible to reduce the weight by 70% and reduce the external size by 60% in comparison with a conventional apparatus using FPC and package IC.

4. Brief Description of the Drawings

FIG.1 is a schematic diagram showing a cross section of a cell in a liquid crystal apparatus used in one preferred embodiment according to the present invention. And FIG.2 is a cross sectional view showing a structure of a data output apparatus.